

CLAIMS

1. In a method for nondestructive inspection of a pipe or tube for anomalies therein, which anomalies can indicate defects such as notches, cuts, cracks, wear or corrosion, using magnetostrictive techniques, of the type which include inducing residual magnetization in at least one thin ferromagnetic strip; circumferentially pressing said thin ferromagnetic strip against said pipe or tube; first locating a transmitter coil adjacent said thin ferromagnetic strip; second locating a receiver coil adjacent said thin ferromagnetic strip; generating a pulse signal in a transmitter control circuit and delivering it to said transmitter coil, said transmitter coil creating magnetostrictively a guided wave in said thin ferromagnetic strip, said thin ferromagnetic strip being coupled to said pipe or tube so that said guided wave propagates along the length of said pipe or tube; generating and delivering a pulse signal; magnetostrictively detecting by said receiver coil said guided wave and any reflected signals in said pipe or tube through said coupled thin ferromagnetic strip, said reflected signals including any caused by said anomalies in said pipe or tube; and determining if said reflected signals were due to said anomalies that should not exist in said pipe or tube, wherein the improvement comprises:

said thin ferromagnetic strip being made from an iron-cobalt alloy.

2. The method for nondestructive inspection of said pipe or tube for anomalies therein using magnetostrictive techniques of claim 1 wherein in said inducing step of said residual magnetization is in a lengthwise direction of said thin ferromagnetic strip and said guided wave is a torsional wave.

1 3. The method for nondestructive inspection of said pipe or tube for anomalies therein using
2 magnetostrictive techniques of claim 1 wherein in said inducing step of said residual
3 magnetization is in a widthwise direction of said thin ferromagnetic strip and said guided wave is
4 a longitudinal wave.

5 4. The method for nondestructive inspection of said pipe or tube using magnetostrictive
6 techniques of claim 2 wherein there are two of said thin ferromagnetic strips, a first of said thin
7 ferromagnetic strips being adjacent said transmitting coil and a second of said thin ferromagnetic
8 strips being adjacent said receiving coil.

9 5. The method for nondestructive inspection of said pipe or tube using magnetostrictive
10 techniques of claim 1 wherein said iron-cobalt alloy comprises at least 40% by weight of cobalt
11 and at least 40% by weight of iron.

12 6. In an apparatus for the nondestructive inspection of a pipe or tube for anomalies therein,
13 which anomalies indicate defects such as notches, cuts, cracks, wear or corrosion, using
14 magnetostrictive techniques, of the type wherein at least one thin ferromagnetic strip has residual
15 magnetization therein, said thin ferromagnetic strip being circumferentially pressed against said
16 pipe or tube; a transmitter coil is located adjacent said thin ferromagnetic strip; a receiver coil is
17 located adjacent said thin ferromagnetic strip; a transmitter control circuit is connected to said
18 transmitter coil for generating a pulse signal and delivering said pulse signal to said transmitter
19 coil, said transmitter coil creating magnetostrictively a guided wave that is coupled from said thin
20 ferromagnetic strip to said pipe or tube to propagate along the length of said pipe or tube;
21 wherein said receiver magnetostrictively detects said guided wave and any reflected signals,
22 including any caused by said anomalies in said pipe or tube; and said transmitter coil and said

receiver coil are wound adjacent said thin ferromagnetic strip so that said guided wave moves perpendicular thereto, wherein the improvement comprises:

said thin ferromagnetic strip being made from an iron-cobalt alloy.

7. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein of claim 6 wherein said residual magnetization is in a lengthwise direction of said thin ferromagnetic strip and said guided wave is a torsional wave.

8. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein of claim 6 wherein said residual magnetization is in a widthwise direction of said thin ferromagnetic strip and said guided wave is a longitudinal wave.

9. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein of claim 8 wherein there are two of said ferromagnetic strips, a first of said thin ferromagnetic strips being adjacent said transmitting coil and a second of said thin ferromagnetic strips being adjacent said receiving coil.

10. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein as given in claim 9 wherein an expansion device inside said pipe or tube circumferentially presses said thin ferromagnetic strip against said pipe or tube.

11. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein as given in claim 9 further includes a pressing device for pressing said first and second thin ferromagnetic strips in a circumferential direction against the outside of said pipe or tube.

12. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein as given in claim 6 wherein said iron-cobalt alloy comprises at least 40% by weight of cobalt and at least 40% by weight of iron.

1 13. A method for nondestructive inspection of a pipe or tube for anomalies therein, which
2 anomalies can indicate defects such as notches, cuts, cracks, wear or corrosion, using
3 magnetostrictive techniques, said method comprising the following steps:
4 inducing residual magnetization in at least one thin iron-cobalt alloy strip;
5 circumferentially pressing said thin iron-cobalt alloy strip against said pipe or tube;
6 first locating a transmitter coil adjacent said thin iron-cobalt alloy strip;
7 second locating a receiver coil adjacent said thin iron-cobalt alloy strip;
8 generating a pulse signal in a transmitter control circuit and delivering said pulse signal to
9 said transmitter coil, said transmitter coil creating magnetostrictively a guided wave in said thin
10 iron-cobalt alloy strip, said thin iron-cobalt alloy strip being coupled to said pipe or tube so that
11 said guided wave propagates along the length of said pipe or tube;
12 magnetostrictively detecting by said receiver coil said guided wave and any reflected
13 signals in said pipe or tube through said coupled thin iron-cobalt alloy strip, said reflected signals
14 including any caused by said anomalies in said pipe or tube and said signal amplitude of said
15 reflected signals being at least four times greater than with coupled nickel strips; and
16 determining if said reflected signals were due to said anomalies that should not exist in
17 said pipe or tube.
18 14. The method for nondestructive inspection of said pipe or tube for anomalies therein using
19 magnetostrictive techniques of claim 13 wherein in said inducing step of said residual
20 magnetization is in a lengthwise direction of said thin iron-cobalt alloy strip and said guided
21 wave is a torsional wave.

15. The method for nondestructive inspection of said pipe or tube for anomalies therein using magnetostrictive techniques of claim 13 wherein in said inducing step of said residual magnetization is in a widthwise direction of said thin iron-cobalt alloy strip and said guided wave is a longitudinal wave.

16. The method for nondestructive inspection of said pipe or tube using magnetostrictive techniques of claim 14 wherein there are two of said thin iron-cobalt alloy strip, a first of said thin iron-cobalt alloy strip being adjacent said transmitting coil and a second of said thin iron-cobalt alloy strip being adjacent said receiving coil.

17. An apparatus for the nondestructive inspection of a pipe or tube for anomalies therein, which anomalies indicate defects such as notches, cuts, cracks, wear or corrosion, using magnetostrictive techniques, said apparatus comprising:

at least one thin iron-cobalt alloy strip that has residual magnetization therein, said thin iron-cobalt alloy strip being circumferentially pressed against said pipe or tube;

a transmitter coil located adjacent said thin iron-cobalt alloy strip;

a receiver coil located adjacent said thin iron-cobalt alloy strip;

a transmitter control circuit connected to said transmitter coil for generating a pulse signal and delivering said pulse signal to said transmitter coil, said transmitter coil creating magnetostrictively a guided wave that is coupled from said thin iron-cobalt alloy strip to said pipe or tube to propagate along the length of said pipe or tube;

said receiver magnetostrictively detecting said guided wave and any reflected signals, including any caused by said anomalies in said pipe or tube, said signal amplitude of said

1 reflected signals being at least four times greater than with coupled nickel strips;

2 said transmitter coil and said receiver coil being wound adjacent said thin iron-cobalt
3 alloy strip so that said guided wave moves perpendicular thereto.

4 18. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein
5 of claim 17 wherein said residual magnetization is in a lengthwise direction of said thin iron-
6 cobalt alloy strip and said guided wave is a torsional wave.

7 19. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein
8 of claim 17 wherein said residual magnetization is in a widthwise direction of said thin iron-
9 cobalt alloy strip and said guided wave is a longitudinal wave.

10 20. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein
11 of claim 18 wherein there are two of said thin iron-cobalt alloy strip, a first of said thin iron-
12 cobalt alloy strip being adjacent said transmitting coil and a second of said thin iron-cobalt alloy
13 strip being adjacent said receiving coil.

14 21. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein
15 as given in claim 20 wherein an expansion device inside said pipe or tube circumferentially
16 presses said thin iron-cobalt alloy strip against said pipe or tube.

17 22. The apparatus for the nondestructive inspection of said pipe or tube for anomalies therein
18 as given in claim 19 further includes a pressing device for pressing said first and second thin
19 iron-cobalt alloy strips in a circumferential direction against the outside of said pipe or tube.